REMARKS

This is a full and timely response to the Office Action mailed May 23, 2008.

No claims have been amended in this response. Thus, claims 1-16 are currently pending in this application.

In view of this response, Applicant believes that all pending claims are in condition for allowance. Reexamination and reconsideration in light of the above amendments and the following remarks is respectfully requested.

Rejections under 35 U.S.C. §102 and §103

Claims 10-12, 14 and 15 are rejected under 35 U.S.C. §102(b) as allegedly being anticipated by Yasuda et al. (U.S. Patent No. 5,949,099). Further, claims 9, 13 and 16 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Yasuda et al. either alone, or in combination with Mizutani et al. (U.S. Patent No. 6,144,407) alone or taken together with Miura (U.S. Patent No. 5,379,067). Lastly, claims 1-8 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Yasuda et al. in view of Miura. Applicant respectfully traverses these rejections.

To constitute anticipation of the claimed invention under U.S. practice, the prior art reference must literally or inherently teach each and every limitation of the claims. Further, to establish a *prima facie* case of obviousness, the cited reference(s) must teach or suggest the invention as a whole, including all the limitations of the claims. Here, in this case, none of the cited references, either alone or in combination, teach or suggest all of the limitations of the claims with particular emphasis on the limitations "*a potential gradient is provided in which potentials about the electric signals gradually change from the light receiver toward said readout unit*" (in claims 1 and 6), "*a first drain structure is disposed adjacent a storage unit adjacent the readout unit or the readout unit for discharging excess part of the electric signals read by said readout unit*" (in claims 10 and 14) and "*said sensor further includes a second drain structure disposed adjacent the light receiver for discharging excess part of said electric signals in said light receiver*" (in claims 11 and 15).

Claims 10-16 of the present application are directed to an image sensor (or apparatus for an image sensor) comprising a light receiver, a readout unit, a plurality of storage units, and a first drain structure for discharging excess part of the electric signals read by said readout unit. **The first drain structure is disposed adjacent a storage unit adjacent the readout unit or the readout unit** (see claims 10 and 14 in the present application). In contrast, Yasuda et al. teaches a first drain structure, such as an electric-charge exhausting drain 22, disposed **in** a readout unit such as a read gate 15, a read gate electrode 19, and a transfer gate electrode 20.

Thus, Applicant believes that Yasuda et al. is different from the present application in the first drain structure. Hence, Applicant respectfully submits that the Examiner's indication that the elements in claims 10 and 14 correspond to those in Yasuda et al. is incorrect.

Further, such deficiency in Yasuda et al. is not cured by the teachings and suggestions of Mizutani et al. since the Examiner has cited Mizutani et al. to teach a solid-state image pickup device which is unrelated to the deficiency of Yasuda et al. noted above.

It should also be noted that the first drain structure can connect to only a portion of the storage unit (i.e., the upstream storage CCD cell) that is adjacent to the readout unit (see Figure 7 of present drawings).

In addition, with regard to claims 11 and 15, Applicant also wishes to emphasize that the image sensor can also comprise a second drain structure disposed adjacent the light receiver for discharging excess part of the electric signals in the light receiver. Thus, in the present invention of claims 11 and 15, there can be two drain structures in the image sensor, the first drain structure for discharging excess electric signals in the storage unit read by the readout unit and the second drain structure for discharging excess electric signals in the light receiver.

In contrast, Yasuda et al. only discloses one exhaust drain (see claim 1 of Yasuda et al. "*an electric-charge exhausting unit for each read gate and its respective pair of photoelectric conversion units being provided between said respective pair of photoelectric conversion elements and said electric-charge transferring unit, . . . said electric-charge exhausting unit comprising an exhaust drain provided within said U-shape of said read gate*"). Furthermore, all excess electric charges of a read gate and a pair light receivers are directed to the same drain (see column 5, lines 31-51, and column 6, lines 7-14, of Yasuda et al.).

Such configuration of Yasuda et al. is clearly different from the present invention. The first drain structure D_1 (see Figure 7 of the present drawings) of the present invention is disposed vertically adjacent to the storage CCD cell (see Figure 7, element 104_1, of the present drawings) adjacent the gate electrode, i.e. the cell most upstream among the storage CCD cells 104, for discharging excess part of the electric signal read by the gate electrode 103. The second drain structure D_2 is disposed adjacent the light receiver (photodiode 102) for discharging excess part of the electric signals in the light receiver. Thus, by placing the first drain structure D_1 and the second drain structure D_2 at such locations, the electric signal can be smoothly transferred downstream of the storage CCD cells, and blooming (i.e. glare or too much light) in a light receiver is avoided (see paragraph [0067], [0068], [0071] and [0072] of the patent application publication).

Applicant also notes that there is one first drain structure for each readout unit and one light receiver in the present invention as compared to one exhausting drain for each read gate and a pair of photoelectric conversion units (i.e., a pair of light receivers) in Yasuda et al. Further, for each readout unit, there are a plurality of storage units (i.e., storage CCD cells) for storing electric charges in the present invention as compared to each electric-charge transferring units 13 including a CCD Channel 14 in Yasuda et al. (see column 4, lines 46-47, of Yasuda et al.). Finally, it appears that for each read gate, there are only two CCD channels in Yasuda et al.

It is also important to emphasize that the excess electric charges in the light receiver and the excess electric charges in the storage CCD cell adjacent the read gate go to different drains. Thus, in the present invention, blooming is avoided and electric signals are smoothly transferred to downstream of the storage CCD cells. These are important features for a high-speed image sensor device. From Applicant's review of Yasuda et al., it appears that Yasuda et al. failed to consider two drains for solving these concerns. Apparently, Yasuda et al. teaches a longer transferring path (i.e., longer time) for the excess electric charges to reach the single drain. Thus, Applicant believes that the configuration in Yasuda et al. is not suitable for a high-speed image sensor.

With regard to the Examiner's rejection of claims 1-9, Applicant submits that the combined teachings of Yasuda et al. and Miura does not disclose or suggest a potential gradient in which potentials about the electric signals **gradually change** from the light receiver toward said readout unit. Claims 1-9 are directed to an image sensor and related apparatus comprising a light

receiver as a light to electric signal converter and a gate electrode as a readout unit. A potential gradient in a light receiver is accomplished by gradually enlarging a width of impurities or by increasing density of impurities forming said light receiver, from the light receiver to the readout unit. As indicated in Figures 2(a) and 9, a photodiode, i.e., a light receiver, may be shaped like letter characters "X" or "Y" which can provide continuous and smooth changes of electric potential from near the center to the gate electrode (see Figure 2(b) of the present drawings). Thus, the electric signals do not stagnate in the center while moving toward the gate electrode.

As indicated by the Examiner, Yasuda et al. does not explicitly disclose a potential gradient. To cure this deficiency, the Examiner cites the teachings of Miura. Miura discloses (see Figure 5 of Miura) that the potentials of the photosensitive portions (1a, 1b) can be sloped down toward the readout gate electrodes (2a, 2b) by the impurity diffused region and that the potential gradient can increase the transfer efficiency of the signal charges (e), and prevent part of the charges from remaining within the photosensitive portions (1a, 1b) (see column 3, lines 50-57, of Miura). However, Applicant notes that the CCD linear sensor discussed in Miura has a channel separating region that is formed along the center of the photosensor row for separating each of the photosensitive region into two photosensitive portions. Thus, read-out gate electrodes and shift registers are formed on each of opposite sides of the photosensor row (see abstract, claim 1 and Figure 3 of Miura). Hence, for each photosensitive portion (1a, 1b) in Miura, the electric signals move from center toward outside all in the same direction and perpendicular to the readout gate.

This is in contrast to the present invention where the gate electrode is connected to only the middle portion of the edge of the photodiode, and the length of the gate electrode is smaller than the edge length of the photodiode. As a result, the electric signals move from each edge toward the center of the photodiode and then toward the gate electrode. Further, it should be noted that not all of the moving directions in a photodiode are perpendicular to the gate electrode (see Figures 2(a), 5 and 9 of the present drawings). Thus, while Miura arguably discloses a potential gradient, the CCD linear sensor in Miura is in a different configuration than the present invention. Thus, Applicant believes that Miura does not teach or suggest a configuration which achieves the effect of providing continuous and smooth changes of electric potential from near the center to the gate electrode (see Figure 2(b) of the present drawings) as in the present invention.

Further, such deficiency in Miura is not cured by the teachings and suggestions of Mizutani et al. since the Examiner has cited Mizutani et al. to teach a solid-state image pickup device which is unrelated to the deficiency of Miura noted above.

Thus, for these reasons, independent claims 1, 6, 10 and 14 are allowable over the teachings and suggestions of the cited references.

Claims 2-5, 7-9, 11-13, 15 and 16, depend directly from claims 1, 6, 10 or 14, and include all of the features of claims 1, 6, 10 or 14. Thus, Applicant submits that the dependent claims are allowable at least for the reasons claims 1, 6, 10 or 14 is allowable as well as for the features they recite (*see, for example, claims 11 and 15, in view of the comments noted above*).

Further, Applicant asserts that there are also reasons other than those set forth above why the pending claims are patentable. Applicants hereby reserve the right to submit those other reasons and to argue for the patentability of claims not explicitly addressed herein in future papers.

CONCLUSION

For the foregoing reasons, all the claims now pending in the present application are believed to be clearly patentable over the outstanding rejections. Accordingly, favorable reconsideration of the claims in light of the above remarks is courteously solicited. If the Examiner has any comments or suggestions that could place this application in even better form, the Examiner is requested to telephone the undersigned attorney at the below-listed number.

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